Destined for Slaughter: Identifying Seasonal Breeding Patterns in Sheep and Goats in Early Babylonia

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Introduction

An improved understanding of the seasonality of birth and breeding activities of sheep and goats in early Mesopotamia will not only contribute to our reconstruction of ancient breeding practices and the strategies of the rhythm of both pastoral and administrative tasks, but also to our overall appreciation of the socio-economic organization of Mesopotamian society in the late third millennium B.C. The reproductive cycle in sheep and goats is a central parameter in animal management systems, and determines not only the availability of animal resources, including milk, but may also have an impact on the timing of various pastoral activities and slaughtering strategies. For the nomadic and semi-nomadic pastoralists and transhumant herders operating in the "periphery" of the Ur III state (as defined by Piotr Steinkeller in his seminal paper from 1991),[1] who supplied a significant portion of the animals that went through the Ur III animal livestock center Puzriš-Dagan, the seasonal breeding cycle of the animals would have been an important factor for the herding of the animals, and would no doubt have played a role in defining the movement of the community as a whole. Moreover, a better understanding of the dynamics of state-pastoralist interaction may also improve our appreciation of the underlying military and political strategies of the Ur III state. Anne Porter has recently argued that Šulgi's militaristic expansion of the Ur III state into the Zagros, which coincided with the foundation

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[1] P. Steinkeller, "The Administrative and Economic Organization of the Ur III State: the Core and the Periphery," in *The Organization of Power: Aspects of Bureaucracy in the Ancient Near East. Second Edition with Corrections*, eds. McG. Gibson and R. D. Biggs, Studies in Ancient Oriental Civilization, vol. 46 (Chicago, IL, 1991), 15-33.

of Puzriš-Dagan, was part of the state's progressive appropriation of all aspects of the economy, and that much of the autonomy and grazing land of the transhumant pastoralists in the northeast of Babylonia and the Zagros mountains were lost in this process of centralization.[2]

This article aims to revisit the debate concerning the meaning of the Sumerian classification $sila_4$/$maš_2$ nu_2/nu-a, used for sexually mature ewes and does in the Ur III administrative texts from Puzriš-Dagan, adopting a more interdisciplinary approach to the discussions by incorporating ethnographic data as well as studies on reproductive patterns of domestic sheep and goats in early Mesopotamia and elsewhere. An analysis of all attestations of the expression in the Ur III record offers important information on the seasonal mating cycle of sheep and goats in Puzriš-Dagan, and supports the understanding of the expression as a reference to infertile animals or poor producers in general, as argued by Wolfgang Heimpel in 1993 and Wu Yuhong in 1996.[3] The correct understanding of the expression in the Sumerian administrative documents allows us to reconstruct the reproductive cycle of the sheep and goats, and if Heimpel and Wu Yuhong are correct in their interpretation of the expression, it would suggest a relatively short mating season in the autumn (September-October), with the majority of the small livestock in Puzriš-Dagan being born in the first few months of the year (February-March).

The administration of the Ur III state has been described as an oppressive and unyielding centralized bureaucracy, with an omnipresent control over all aspects of Mesopotamian society and economy. This rather bleak picture of the Ur III organization has recently been challenged by Steven Garfinkle, who has argued for a more nuanced understanding of the Ur III state, as a patrimonial household economy characterized by the persistence of local hierarchies.[4] Ultimately, our understanding of the nature of the Ur III bureaucracy must be based on our interpretation of the Ur III administrative texts. An enhanced understanding of the interrelation between the royal administrators

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[2] A. Porter, *Mobile Pastoralism and the Formation of Near Eastern Civilizations: Weaving Together Society* [New York, NY, 2012], 296-97.

[3] W. Heimpel, "Zu den Bezeichnungen von Schafen und Ziegen in den Drehem- und Ummatexten," *Bulletin on Sumerian Agriculture* 7 (1993): 115-60; Y. Wu, "The Ewes Without Lambs and the Lambs Cooked in e_2-uz-ga, "The Private House of Kings", in the Drehem Archives," *Journal of Ancient Civilizations* 11 (1996): 65-109.

[4] S. J. Garfinkle, "Was the Ur III State Bureaucratic? Patrimonialism and Bureaucracy in the Ur III Period," in *The Growth of an Early State in Mesopotamia: Studies in Ur III Administration: Proceedings of the First and Second Ur III Workshops at the 49th and 51st Rencontre Assyriologique Internationale London July 10, 2003 and Chicago July 19, 2005*, eds. S. J. Garfinkle and C. J. Johnson, Biblioteca del Próximo Oriente Antiguo, vol. 5 (Madrid, 2008), 55-61. Other recent studies that have a argued for a more balanced approach to the Ur III state, with a greater emphasis on continuity than on transition and disruption, include S. Garfinkle, "The Third Dynasty of Ur and the Limits of State Power in Early Mesopotamia," in *From the 21st Century B.C. to the 21st Century A.D. Proceedings of the International Conference on Sumerian Studies Held in Madrid 22–24 July 2010*, eds. S. Garfinkle and M. Molina (Winona Lake, IN, 2013), 153-67; P. Michalowski, "Charisma and Control: On Continuity and Change in Early Mesopotamian Bureaucratic Systems," in *The Organization of Power: Aspects of Bureaucracy in the Ancient Near East. Second Edition with Corrections*, eds. McG. Gibson and R. D. Biggs, Studies in Ancient Oriental Civilization, vol. 46 (Chicago, IL, 1991), 45-57; and P. Michalowski, "Networks of Authority and Power in Ur III Times," in *From the 21st Century B.C. to the 21st Century A.D. : Proceedings of the International Conference on Neo-Sumerian Studies held in Madrid 22-24 July 2010*, eds. in S. J. Garfinkle and M. Molina (Winona Lake, IN, 2013), 169-205.

operating in Puzriš-Dagan (and Ur[5]) and the pastoral communities in the outlying territories of the state, may shed light on how – and to what extent – the central authority and its administrative apparatus influenced and controlled the lives and livelihood of the people living in these marginal areas. The article argues that the administration and bureaucracy of the Ur III state remained largely insusceptible to the seasonal reproductive cycles in the sheep and goats collected in Puzriš-Dagan.

The Ur III Livestock Center Puzriš-Dagan

The livestock management center Puzriš-Dagan was officially established by the Ur III king Šulgi, announced in the name of his 39th year as the king of the state, with the main purpose of collecting, registering and managing different types of livestock, which often (but not always) was brought in from the outer regions of the state. Most of the livestock, which was primarily destined for consumption and cult observances, was distributed from Puzriš-Dagan to the major temples and important institutions in the cities in central and southern Babylonia, although some animals would also be added to local herds administrated by the palace, and distributed to the "fields" (a-ša$_3$) around Puzriš-Dagan.[6] The majority of the livestock appears to have been brought in as different types of taxes or as loot from military campaigns, from the peripheral areas of the state north- and northeast of Babylonia along the Zagros range.[7] Puzriš-Dagan itself was in all likelihood located on a branch of the Euphrates,[8] some 10 kilometers southeast of Nippur in central Babylonia, and geographically the center was part of the province of Nippur.[9] However, contrary to the Ur III provincial capitals and their subsidiary cities and towns, which largely operated within their own administrative and economic structures, Puzriš-Dagan was directly subordinated the royal bureaucracy. It was an

[5] See Ch. Tsouparopoulou, "A Reconstruction of the Puzriš-Dagan Central Livestock Agency," *Cuneiform Digital Library Journal* 2013/2 (2013): 10-11, accessed on 05/14/2019 at https://cdli.ucla.edu/pubs/cdlj/2013/cdlj2013_002.html; E. Cripps, "The Structure of Prices in the Ur III Economy: Cults and Prices at the Collapse of the Ur III State," *Journal of Cuneiform Studies* 71/1 (2019): 57 n. 12.

[6] W. Sallaberger, "Schlachtvieh aus Puzriš-Dagān. Zur Bedeutung dieses königlichen Archivs," *Jaahrbericht Ex Oriente Lux* 38 (2004): 47.

[7] Steinkeller "Administrative and Economic Organization": 27-32; see also Sallaberger "Schlachtvieh aus Puzriš-Dagān": 48. For a more recent survey of the eastern and northern military expansion of the Ur III state, see P. Michalowski, *The Correspondence of the Kings of Ur: an Epistolary History of an Ancient Mesopotamian Kingdom* (Winona Lake, IN, 2011), 96-105; and Garfinkle, "Limits of State Power in Early Mesopotamia": 160-62.

[8] P. Steinkeller, "New Light on the Hydrology and Topography of Southern Babylonia in the Third Millennium," *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 91/1 (2001): 22-84.

Recent studies on the archaeology of Puzriš-Dagan include Ch. Tsouparopoulou, "'Counter-Archaeology': Putting the Ur III Drehem Archives Back in the Ground," in *At the Dawn of History: Ancient Near Eastern Studies in Honour of J. N. Postgate*, eds. Y. Heffron, A. Stone, and M. Worthington [Winona Lake, IN, 2017], 611-29; A. U. Shalkham, "The Iraqi Excavation at Drehem (First Season 2007)," in N. Al-Mutawalli and W. Sallaberger, "The Cuneiform Documents from the Iraqi Excavation at Drehem," *Zeitschrift für Assyriologie* 107/2: 151-156; and N. Marchetti, B. Einwag, A. Al-Hussainy, G. Luglio, G. Marchesi, A. Otto, G. Scazzosi, E. Leoni, M. Valeri and F. Zaina, "QADIS. The Iraqi-Italian 2016 Survey Season in the South-Eastern Region of Qadisiyah," *Sumer* 63 (2017): 63-92.

[9] T. Sharlach, *Provincial Taxation and the Ur III State*, Cuneiform Monographs, vol. 26 (Leiden, 2004), 11.

artificial creation by the king as an administrative and economic tool of the state, and all officials operating within this extensive livestock redistributive system were selected by the king himself.[10]

The Sumerian Expression u_8 $sila_4$ nu_2/nu-a and ud_5 $maš_2$ nu_2/nu-a

Pregnant

The Sumerian expressions u_8 $sila_4$ nu_2/nu-a and ud_5 $maš_2$ nu_2/nu-a were used as a classification for a specific type of ewes (u_8) and does (ud_5) in the Ur III administrative texts from the livestock center Puzriš-Dagan. I know of only one attestation, from the city of Nippur, where the expression was used in an identical format as a designation for cows: ab_2 amar nu_2-a (*BE* 3-1 79; see further below). The traditional and currently prevailing understanding of the expression is as a designation for pregnant ewes and does. However, it has been known for some time that this understanding produces several contextual and philological problems, and our interpretation of the expression warrants some further consideration.

It was Leo Oppenheim who first suggested in 1948 that the expression alluded to pregnant animals, translating u_8 $sila_4$ nu_2-a "sheep big with lamb," referring to the meaning "to cover" for the verb in the expression, which he read as na_2.[11] Oppenheim did not connect the nu_2-a in his text with the nu-a, which he instead understood as a phonetic variant of the du_3-a used in the otherwise identical expression u_8/ud_5 $sila_4$/$maš_2$ du_3-a; an expression he believed was used for animals after parturition: "she-goat which has kidded" or "ewe which has (already) ewed."[12] However, we may now with some confidence conclude that the expression u_8/ud_5 $sila_4$/$maš_2$ du_3-a was used as a designation for pregnant animals in the Ur III texts.[13]

Oppenheim did not further elaborate on his understanding of the verb na_2 as "to cover" in favor of the more established translation "to lie down" (Akk. *niālum*) offered in, e.g., Anton Deimel's *Šumerisches Lexikon*,[14] the standard Sumerian dictionary at the time. It is surprising that Oppenheim did not consider this meaning of the verb, since both ewes and does often (but not always) do give birth lying down, and a translation of the expression as "ewe/doe that will lay down (with) lamb/kid"

[10] Ch. Tsouparopoulou, *The Ur III Seals Impressed on Documents from Puzriš-Dagān (Drehem)*, Heidelberger Studien zum Alten Orient, vol. 16 (Heidelberg, 2015), 9.
[11] A. L. Oppenheim, *Catalogue of the Cuneiform Tablets of the Wilberforce Eames Babylonian Collection in The New York Public Library. Tablets of the Time of the Third Dynasty of Ur*, American Oriental Series, vol. 32 (New Haven, CT, 1948), 82.
[12] Oppenheim, *Wilberforce Eames Babylonian Collection*: 11.
[13] See, e.g., Heimpel "Bezeichnungen von Schafen und Ziegen": 134; P. Steinkeller "Sheep and Goat Terminology in Ur III Sources from Drehem," *Bulletin on Sumerian Agriculture* 8 (1995): 55. For the ab_2 amar du_3-a next to the ab_2 amar nu_2-a in *BE* 3-1 79, see also Oppenheim, *Wilberforce Eames Babylonian Collection*, 82 (and below).
[14] P. A. Deimel, *Šumerisches Lexikon. II Teil: Vollständige Ideogramm-Sammlung. Band 3* (Rome, 1932), no. 431.

would work well contextually with Oppenheim's understanding of the expression as a designation for pregnant animals. Oppenheim also did not explain how or why his understanding of the verb na_2 as "to cover," thus offering the literal translation of the expression "ewe/doe (to be) covered with lamb/kid," should be translated "ewe/doe big with lamb/kid,"[15] and – by extension – be understood as a reference to pregnant animals.

Benno Landsberger continued to read the verb in the expression as na_2 (rather than nu_2), but noted that the frequently occurring nu-a was not – as argued by Oppenheim – a variant of du_3-a in the expression u_8/ud_5 $sila_4$/$maš_2$ du_3-a, but should instead be understood as a phonetic variant of na_2-a.[16] In Tablet 13 of the bilingual lexical series ḪAR-ra = *ḫubullû*, which date to the Old Babylonian period, the nu_2-a appeared to correspond to the Akkadian adjective *nīlum* "recumbent," producing the translation "recumbent ewe (with) her lamb" (line 190) or "recumbent cow (with) her calf" (line 339), which Landsberger naturally, and in agreement with Oppenheim, interpreted as a designation of pregnant animals.[17]

Infertile

The u_8/ud_5 $sila_4$/$maš_2$ nu_2/nu-a was revisited in 1993, when Wolfgang Heimpel offered an alternative analysis and interpretation of the expression in a comprehensive study on Ur III sheep and goat terminology published in the biannual *Bulletin on Sumerian Agriculture*. According to Heimpel, the nu_2 should be understood as a phonetic variant of the nu (rather than the other way around).[18] The nu-a would simply mean "without," formed with the modal prefix nu- used for negations, and the subordination suffix -a.[19] The expression would thus be translated "ewe/doe without lamb/kid," which Heimpel interpreted as a designation used for infertile or barren animals. It should be noted that an expression nu-a with the meaning "without" does not appear in other contexts in the Ur III texts beyond ewes and does.

If Heimpel's interpretation is correct, the expression would stand in a natural opposition to the structurally identical animal designation u_8/ud_5 $sila_4$/$maš_2$ du_3-a, which in all likelihood should be

[15] Note that Oppenheim and Hartman also offered the translation "ewe big with lamb" for the expression, using what they (incorrectly) reconstructed as [d]u-a, in their edition of ḪAR-ra = *ḫubullû*, Tablet 13 (A. L. Oppenheim and L. F. Hartman, "The Domestic Animals of Ancient Mesopotamia According to the XIIIth Tablet of the Series ḪAR.ra = *ḫubullû*." *Journal of Near Eastern Studies* 4/3 [1945]: 166-67).
[16] B. Landsberger, *The Fauna of Ancient Mesopotamia. First Part. Tablet* XIII, Materialien zum Sumerischen Lexikon, vol. 8/1 (Rome, 1960), 27 and 49.
[17] Landsberger, *Fauna of Ancient Mesopotamia*, 27 and 56.
[18] Heimpel "Bezeichnungen von Schafen und Ziegen": 133-34.
[19] See M.-L. Thomsen, *The Sumerian Language. An Introduction to its History and Grammatical Structure*, Mesopotamia. Copenhagen Studies in Assyriology, vol. 10 (Copenhagen, 1984), 92. Note that the understanding of nu-a as "without," and the possible connection with nu_2-a in our expression, was in fact proposed by Dietz Otto Edzard almost 20 years before Heimpel's article (D. O. Edzard, "Hamṭu, marû und freie Reduplikation beim sumerischen Verbum. III," *Zeitschrift für Assyriologie und Vorderasiatische Archäologie* 66/1 [1976]: 61).

understood as "ewe/doe planted (with) lamb/kid," i.e., a pregnant animal.[20] The aforementioned text *BE* 3-1 79 from Nippur is of relevance here. This text records 3 cows as amar nu_2-a immediately after it enumerates +1 cow(s) described as amar du_3-a. In other words, if we agree with Heimpel and Steinkeller that ab_2 amar du_3-a is a reference to pregnant cows, then it obviously follows that ab_2 amar nu_2-a cannot be an identical reference to pregnant cows. Steinkeller was, of course, aware of these references in *BE* 3-1 79,[21] but he did not elaborate on the implications of this text for our understanding of either of these two expressions.

The recently published text *PPAC* 5 315 from Girsu provides further support for Heimpel's rejection of ab_2 amar nu_2-a as a designation for pregnant cows, and offers some validation for his understanding of the nu_2-a/nu-a as "without" in this particular context. In this text, several small groups of calves are referred to with the expression amar ab_2 nu_2-a. The understanding of amar ab_2 nu_2-a as "calf without cow," with nu_2-a as a phonetic variant of nu-a "without," would be perfectly feasible, and seems to fit the context in the text very well, since the calves listed in this way are the only ones in the text that are not referred to as suckling animals. Naturally, these "calves without cows" (i.e. orphaned or abandoned calves) would not be suckling animals. On the other hand, and for obvious reasons, the alternative understanding of the expression as "calf pregnant with cow" must be rejected here. In the final column, *PPAC* 5 315 provides the following totals (ŠU+$NIGIN_2$): 222 suckling heifer calves (ab_2 amar ga), 228 suckling bull calves (gu_4 amar ga), and 11 "calves without cows" (amar ab_2 nu_2-a). These numbers would indicate that 2-3% of the Ur III calves would be orphaned or rejected by their mothers. Occurrences of cows initially (and sometimes permanently) rejecting their calves are relatively rare in livestock breeding, and would primarily happen with first time heifers. Illmann and Špinka observed only one rejection of a new born calf in a sample of 31 dairy heifers in group housing (3.2%).[22] It should be noted, however, that both housing conditions and various bonding strategies greatly affect cow-calf rejection rates,[23] and the rates in modern breeding scenarios will no doubt differ from those in ancient Mesopotamia.

A clear advantage with Heimpel's re-interpretation of the expression is that it would explain the fact that some of the animals "without lamb/kid" were destined for consumption and disbursed to the (royal) kitchen – or commissariat – referred to as e_2-muhaldim, or to the mysterious institution e_2-uz-ga, perhaps "House of Restriction" from $uzug_2$ "taboo," which – among other things – prepared

[20] See Heimpel "Bezeichnungen von Schafen und Ziegen": 134; Steinkeller "Sheep and Goat Terminology": 55. Note that a similar structural opposition is attested in Puzriš-Dagan, with dead animals designated as "among the newborn (ones)" ($ša_3$ u_4-tu-da) beside animals designated as "among the old (ones)" ($ša_3$ libir) (see M. Hilgert, *Drehem Administrative Documents from the Reign of Amar-Suena*, Oriental Institute Publications 121 (Chicago, 2003), 71 and 74, nn. 243 and 244).
[21] See Steinkeller "Sheep and Goat Terminology": 68 and 94.
[22] G. Illman and M. Špinka, "Maternal Behaviour of Dairy Heifers and Sucking of their Newborn Calves in Group Housing," *Applied Animal Behaviour Science* 36 (1993): 93.
[23] M. A. G. Von Keyserlingk and D. M. Weary, "Maternal Behavior in Cattle," *Hormones and Behavior* 52 (2007): 106-113.

exclusive food for the royal court and the upmost elite of Ur III society.[24] Obviously, such frequent disbursements would tally poorly with Oppenheim's original interpretation as a reference to pregnant animals, since it would be difficult to explain why the Ur III administration should identify and deliberately select pregnant animals for slaughtering and consumption. The opposite, on the other hand, i.e., the identification and selection of infertile animals for culling and consumption, would be reasonable and expected in any breeding scenario, ancient or modern.

Aside from the apparent lack of support in the Old Babylonian lexical text ḪAR-ra = *ḫubullû*, Tablet 13, the main problem with Heimpel's analysis and interpretation of the expression is no doubt the use of the graphically complicated sign nu_2 as a phonetic representation of the extremely simple sign nu. According to Heimpel, nu_2 was replaced by nu sometime towards the end of Amar-Suen 3,[25] although he also acknowledged that there are several exceptions to this general observation, and he (correctly) pointed out that the replacement of the sign nu_2 with a phonetic rendering using the simple sign nu would be perfectly reasonable. Heimpel struggled to provide a satisfactory explanation for the real problem here, which is the seemingly inexplicable circumstance that the Ur III administrators originally should have decided to render the intended nu sign with the more complicated sign nu_2:[26]

> Ich nehme daher an, dass etymologisches **nu** in Drehem aus unefindlichen Gründen bis AS 3 mit dem komplizierten Zeichen **nú** geschrieben wurde.

Pregnant – Again

Heimpel's radical reinterpretation of the animal designation would not go unchallenged. In the following volume of the *Bulletin on Sumerian Agriculture* from 1995, in an exhaustive article on sheep and goat terminology in Puzriš-Dagan, Piotr Steinkeller argued against Heimpel's interpretation, in favor of the traditional understanding of the expression. Steinkeller's primary objection to Heimpel's new interpretation of the expression was that it was very common in the texts from Puzriš-Dagan:[27]

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[24] Wu "Ewes Without Lambs": 73-76. For the e_2-muhaldim as an industrial kitchen or commissariat, responsible for the preparation and provision of food to local officials and administrators, work gangs, royal messengers, foreign envoys and military personnel, see Sallaberger "Schlachtvieh aus Puzriš-Dagān": 58-60; and L. B. Allred, *Cooks and Kitchens: Centralized Food Production in Late Third Millennium Mesopotamia* , Ph.D. Dissertation, Johns Hopkins University (Baltimore, MD, 2006). For the e_2-uz-ga, see M. Sigrist, *Drehem* (Bethesda, MD, 1992), 158-62; Wu "Ewes Without Lambs"; Y. Wu, "The Pairs of Cooks in the Royal Dining Hall and the Akiti Calendar during Šulgi 45-48," *Journal of Ancient Civilizations* 28 (2013): 65-103; and Sallaberger "Schlachtvieh aus Puzriš-Dagān": 58-60.

[25] Heimpel "Bezeichnungen von Schafen und Ziegen": 133.

[26] Heimpel "Bezeichnungen von Schafen und Ziegen": 133. It should be noted that nu-a (rather than nu_2-a) is occasionally also attested in texts dating to the period before the end of Amar-Suen 3 (e.g. *BCT* 1 35 [Šulgi 46], *NYPL* 4 [Šulgi 46], *UDT* 104 [Amar-Suen 1]).

[27] Steinkeller "Sheep and Goat Terminology": 55.

> In my view, this interpretation is extremely unlikely, primarily because this description is very common at Drehem.

Although we may conclude that the animal description under discussion here can be attested almost 300 times in approximately 200 different tablets from Puzriš-Dagan,[28] Steinkeller's assessment of the expression as "very common" in the city is rather subjective, and requires some consideration. According to the online catalogues of the *Cuneiform Digital Library Initiative* (*CDLI*) and the *Database of Neo-Sumerian Texts* (*BDTNS*),[29] approximately 16,000 cuneiform tablets from Puzriš-Dagan have been published to date, of which approximately 97% come from a period of 30 years, from Šulgi 39 to Ibbi-Suen 2.[30] Practically all of these texts can be connected to Puzriš-Dagan's main role as a center within the Ur III state for the collection, management and distribution of livestock, and approximately half of all published tablets from Puzriš-Dagan (i.e. some 8,000 tablets) are concerned with small livestock, together producing approximately 30,000 individual references to (groups of) different kinds of sheep and goats. Based on the text *AO* 19548,[31] listing animals disbursed from the account of Nasa over a period of 60 months during the final years of Šulgi's reign,[32] Marcel Sigrist was able to calculate that, on the average, some 70,000 ovines were booked out of Puzriš-Dagan annually. Sigrist further suggested that in order to sustain the animal stocks managed by Puzriš-Dagan, it was unlikely that more than an estimated 5% of the total number of animals would be booked out in a single year,[33] which in turn would mean that at any given time, more than a million sheep and goats were administered by the various officials stationed in Puzriš-Dagan.[34]

Considering such astonishing numbers (and regardless of the exactness and accuracy of such estimates), it is difficult to accept Steinkeller's argument that some 200 tablets listing approximately

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[28] According to the *Database of Neo-Sumerian Texts* (*BDTNS*) there are 278 attestations in 199 different tablets, and a total of 745 individual animals with the classification (296 ewes and 449 does) (http://bdtns.filol.csic.es, accessed on 01/26/2019).
[29] See https://cdli.ucla.edu and http://bdtns.filol.csic.es.
[30] See Tsouparopoulou, *Ur III Seals*, 12.
[31] See D. Calvot, "Deux documents inédits de Selluš-Dagan," *Revue d'assyriologie et d'archéologie orientale* 63/2 (1969): 101-114.
[32] Nasa was the chief official in Puzriš-Dagan between Šulgi 42 and Amar-Suen 2 (Tsouparopoulou "Puzriš-Dagan Central Livestock Agency").
[33] Sigrist, *Drehem*, 33-34.
[34] That so many animals should have been physically kept in or around Puzriš-Dagan seems questionable based on logistics alone, and we have to agree with, e.g., Christina Tsouparopoulou, that many of the animals appearing in the Puzriš-Dagan texts in all likelihood were managed elsewhere, and only entered the livestock center as records and numbers in its administrative documentation (Tsouparopoulou "Counter-Archaeology": 615-16). Note, however, John Robertson, who has argued that the records from Puzriš-Dagan concern collections of animals, and that the center may have kept as many as 350,000 sheep and goats in any given year (J. F. Robertson, "The Social and Economic Organization of Ancient Mesopotamian Temples," in *Civilizations of the Ancient Near East*, ed. J. M. Sasson [New York, NY, 1995], 446). For a general discussion of Ur III institutions – and their archives – actively involved in real transactions, as well as serving as purely administrative units separated from any physical activities, see P. Steinkeller, "The Function of Written Documentation in the Administrative Praxis of Early Babylonia," in *Creating Economic Order: Record-Keeping, Standardization, and the Development of Accounting in the Ancient Near East*, eds. M. Hudson and C. Wunsch (Bethesda, MD, 2004), 65-88; and M. Widell, "The Administration of Storage in Early Babylonia," *Orient: Reports of the Society for Near Eastern Studies in Japan* 53 (2018): 23-34. For a recent discussion of the administrative function of Ur III texts and archives, see S. J. Garfinkle, "Ur III Administrative Texts. Building Blocks of State Community," in *Texts and Contexts: The Circulation and Transmission of Cuneiform Texts in Social Space*, eds. P. Delnero and J. Lauinger (Boston, MA/Berlin, 2015), 143-65.

750 sheep and goats with the designation under discussion should make it "too common" for Heimpel's reinterpretation. On the contrary, if these 750 animals, over this 30-year period, were indeed classified as barren or infertile as Heimpel has suggested, we would have to conclude that animal infertility was severely underreported in Puzriš-Dagan.

The Identification of Infertility and Poor Producers, Selective Culling, and Slaughtering for Consumption

Steinkeller also pointed out that the comparable expression using du_3-a (instead of nu_2/nu-a) – almost certainly being a reference to pregnant animals – remains rare in the texts, and he concluded:[35]

> If the former expression [u_8/ud_5 $sila_4$/$maš_2$ nu_2/nu-a] were to mean "infertile", we would be forced to conclude that, at Drehem, infertile animals were regularly identified (by what means and for what purpose?), whereas pregnant ones [referred to with u_8/ud_5 $sila_4$/$maš_2$ du_3-a] were not. This I find impossible to accept.

However, this notion fails to recognize the importance of the proper identification of infertile or non-productive animals in any animal management system, and that it is standard practice among sheep and goat breeders to identify and remove poor breeders from the herds.[36] A recent study of traditional livestock breeding practices among Somali pastoralists has demonstrated that out of 15 different criteria for culling ewes and does, the inability to become pregnant (infertility) was considered the second most important, followed only by old age as the principal criteria.[37] Other relevant culling criteria among the sheep and goat pastoralists included animals with a history of abortion (6th most important), stillbirth (8th), and death of offspring after abandonment (9th). In traditional sheep and goat husbandry, the voluntary culling of mature animals for non-conception would have been an important factor in maintaining and improving flock productivity over a longer period of time, and it would seem very unlikely that the Ur III administration should have been lacking established routines and practices for selective culling in its meticulously managed sheep and goat herds.

Pregnancy in sheep and goats is not easily detected based simply on visual inspection or palpitation, and can often only be securely identified towards the end of the gestation period, which is

[35] Steinkeller "Sheep and Goat Terminology": 55.
[36] For example, the Ohio State University "Sheep Team" considers poor productivity the most important factor when culling the flock, and offers the following advice to modern sheep breeders (https://u.osu.edu/sheep/2008/08/29/culling-the-sheep-flock/, accessed on 03/12/2019): "When deciding which ewes should be culled from the flock, first eliminate those open ewes and those that have lost lambs due to excessive lambing difficulty, as well as those ewes that have prolapsed or have shown that they are prone to a prolapse condition. A ewe that does not breed one time will lose a significant amount of her lifetime production potential. It will take the returns of 2-3 productive ewes to pay for the maintenance of one open ewe."
[37] K. Marshall, N. Mtimet, F. Wanyoike, N. Ndiwa, H. Ghebremariam, L. Mugunieri, and R. Costagli, "Traditional Livestock Breeding Practices of Men and Women Somali Pastoralists: Trait Preferences and Selection of Breeding Animals," *Journal of Animal Breeding and Genetics* 133 (2016): 544. The all female group of Somali pastoralists actually considered infertility in does the most important criteria for culling.

approximately 5 months for both sheep and goats.[38] However, there are two relatively easy ways of identifying poor breeders or infertility in ewes and does based on observation alone. The first opportunity for such observations is from the very beginning of, and throughout, the mating season, while the second opportunity arises from the end of the gestation period, and throughout the period of parturition. The two opportunities can be described as follows:

1) Ewes/does are only receptive to sexual advances from the ram/buck during estrus (i.e., when "in heat"), which for ewes and does will last between 12 to 36 hours. The estrus is followed by a "breeding rest," during which the ewe or doe will not stand and allow the ram or buck to breed her. The estrus cycle is repeated every 13 to 19 days for sheep, and 18 to 24 days for goats. If a ewe or doe for some reason is repeatedly (i.e., in more than one estrus cycle) not coming into heat, and therefore never mounted by the ram/buck in the herd, she should be considered for culling in order to achieve and maintain the most productive demographic structure in the herd. Identification of ewes/does not pairing is best done through constant observation of the herd. Alternatively, ochre dye can be applied to the chests of the rams/bucks used to service the herd. The dye will rub off onto the ewes/does during pairing, thus singling out any females not being mounted.

2) Towards the end of gestation it is possible for an experienced shepherd to identify pregnant ewes and does in the herd, and therefore also the animals that failed to conceive. All sexually mature female animals are expected to reproduce in any meaningful breeding scenario, and non-pregnant ewes and does should therefore be identified at this point, and considered for possible culling. Other ewes and does may have successfully conceived, but would then fail to give birth or to take care of their offspring. Such animals would typically be identified wandering about with a bloodstained or wet rear end, but without any sign of a healthy lamb or kid. These ewes or does have either aborted, or given birth to healthy lambs/kids which they have then abandoned. These ewes/does can be paired with newborn lambs/kids whose mothers have died during the birth,[39] or be identified and set aside for culling in order to improve the long-term productivity of the herd.

Why would we expect animal infertility and non-conception among ewes and does to be recorded, while pregnancies were not? Because all sexually mature ewes and does were expected to conceive every year, and approximately one third of the lives of all healthy female sheep and goats would be in a state of pregnancy. This would have been the norm for over 90% of the Ur III ewes and does, and

[38] As pointed out by Ajay Kumar Ishwar, abdominal palpation and ballotment are only effective as methods to detect pregnancy in sheep and goats during late gestation. Ishwar further notes that access to reliable techniques for early detection of pregnancies are important to aid the culling of infertile ewes and does in the herd (A. K. Ishwar, "Pregnancy Diagnosis in Sheep and Goats: A Review," *Small Ruminant Research* 17 [1995]: 37-44).

[39] See L. Beck, *Nomad: a Year in the Life of a Qashqa'i Tribesman in Iran* (Berkley/Los Angeles, CA, 1991), 106.

the identification and recording of pregnancies in the textual record would therefore not serve any administrative purpose.[40] On the other hand, the much rarer occurrences of infertility, abortion or non-conception among the ewes/does would certainly justify inclusion in the administrative record, primarily because any productive animal management system (modern or ancient) would require some form of reaction to these occurrences, but also because of the standard practice within the Ur III administration to record rare anomalies rather than the obvious. Infertility or non-conception in ewes and does would be rare, whereas annual pregnancies would be the expectation for all sexually mature ewes and does.[41] Indeed, the numbers of animals classified with $sila_4$/$maš_2$ nu_2/nu-a in the different Ur III texts are typically very modest. Note, e.g., *AUCT* 2 386 (lines 1-6) from the seventh month of Šu-Suen 9, in which a total of 631 animals are documented as 213 sheep (udu), 94 ewes (u_8), 30 "messenger lambs" ($sila_4$ kin-gi_4-a)[42] and 294 yearling lambs ($sila_4$ gub), with a specific notation added that the group of animals – with the 94 ewes – did not include any u_8 $sila_4$ nu_2-a.

Finally, Steinkeller pointed out that in Puzriš-Dagan, animals classified as ba-$uš_2$ referred to both slaughtered animals and animals dead by natural causes, such as by disease or accident, and that we therefore should not presuppose that the ewes and does under discussion were transferred to the slaughter house.[43] However, as noted by Wu Yuhong (see below), this argument is of no consequence for our understanding of the classification of these animals, since the animals described with the expression clearly were intended for human consumption (often by the king himself), and only slaughtered animals would be consumed by humans in the Ur III period.[44]

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[40] A study of a village breeding program of the Arabic sheep native to the Khuzestan province of Iran have shown an average lambing rate of 95% with 1.08 lambs per birth, and an average of one ram for every 20 ewes in the herd (A. Haghdoost, A. A. Shadparvar, M. T. B. Nasiri, and J. Fayazi, "Estimates of Economic Values for Traits of Arabic Sheep in Village System," *Small Ruminant Research* 80 [2008]: 92).

Note that the Ur III standard projection of growth in sheep herds kept for wool in Umma and Lagaš was only 50% of the adult ewes in the herds. However, although this overall growth projection is based on the number of ewes in the herds, it does not reflect their actual reproductive rate, since the projection assumes that no animals in these herds would die. The administrative projection of death in sheep herds in Old Babylonian Larsa was 15%, and if this percentage is applied to the Ur III herds in Umma and Lagaš, an overall growth projection of 50% per ewe in these herds would represent a theoretical reproductive rate of approximately 94% (see M. Liverani and W. Heimpel, "Observations on Livestock Management in Babylonia," *Acta Sumerologica* 17 (1995): 135-44).

[41] Cf. the Ur III worker lists, in which any (rare) occurrences of sickness among the workers would always be highlighted, whereas the fitness and overall readiness of the workers would be the expectation, and therefore not specifically recorded in the lists (see e.g. M. Widell, "Two Ur III Texts from Umma: Observations on Archival Practices and Household Management," *Cuneiform Digital Library Journal* 2009/6 (2009), accessed on 07/22/2019 at https://cdli.ucla.edu/pubs/cdlj/2009/cdlj2009_006.html).

[42] The $sila_4$ kin-gi_4-a referred to male lambs that possibly were destined to be slaughtered for the purpose of divination and extispicy (see Heimpel "Bezeichnungen von Schafen und Ziegen": 131-32).

[43] Steinkeller "Sheep and Goat Terminology": 55. For further discussion on the term ba-$uš_2$, see R. K. Englund, "Worcester Slaughterhouse Account," *Cuneiform Digital Library Bulletin* 2003/1 (2003), accessed on 12/20/2019 at https://cdli.ucla.edu/pubs/cdlb/2003/CDLB2003_001.html; and Ch. Tsouparopoulou, "Killing and Skinning Animals in the Ur III Period: The Puzriš-Dagan (Drehem) Office Managing of Dead Animals and Slaughter By-products," *Altorientalische Forschungen* 40/1 (2013): 153.

[44] According to Robert McC. Adams, animals dead by natural causes would in the Ur III period be given to dogs and servile women, while slaughtered animals were destined for elite consumption and cult observances (R. McC. Adams, "Shepherds at Umma in the Third Dynasty of Ur: Interlocutors with a World beyond the Scribal Field of Ordered Vision," *Journal of the Economic and Social History of the Orient* 49/2 [2012]: 152).

Infertile – Again

Almost immediately after Steinkeller's response and rejection of Heimpel's theory appeared in the *Bulletin on Sumerian Agriculture*, Wu Yuhong published a comprehensive article on the exclusive royal institution referred to as e_2-uz-ga, in which he revisited the debate of the meaning of u_8/ud_5 $sila_4$/$maš_2$ nu_2/nu-a. Wu Yuhong agreed with Benno Landsberger and others that the nu_2 "to lie down" was the actual and intended verb in the expression, and that the nu was only a phonetic rendering of the complicated sign nu_2 introduced from the 4th year in Amar-Suen's reign. However, Wu Yuhong then concurred with Heimpel's broader understanding of the expression, and argued that the expression was used to describe infertile animals, and he further expanded the meaning to also include ewes and does which, for one reason or the other, had aborted their fetuses and those which gave birth to stillborn lambs and kids.[45]

Wu Yuhong offered the very simple and seemingly reasonable translation and analysis of the expression as "ewe/doe (whose) lamb/kid lied down" where the "lying down" should be understood as a reference for being dead.[46] According to Wu Yuhong, the scribal convention of using the sign nu instead of nu_2 from Amar-Suen 4 and onwards, would with this interpretation be even more reasonable, since the expression "ewe/doe who has no lamb/kid" would be synonymous, or at least interchangeable, with an expression meaning "ewe/doe (whose) lamb/kid lied down (in death)" (1996, 66-67).[47]

Like all previous interpretations of the expression, Wu Yuhong's analysis and his final conclusions in his 1996 article were primarily based on the contexts in which the expression occurred in the Ur III texts, and, like Heimpel before him, he strongly rejected the idea that pregnant animals should be earmarked for consumption. As for Steinkeller's observation that the ba-$uš_2$ in Puriš-Dagan was used for both slaughtered animals and animals that died of natural causes, he argued that the animals were specifically delivered to the kitchen (e_2-muhaldim) or the exclusive e_2-uz-ga institution, and that Sumerians only ate animals that had been slaughtered and not died by natural causes. According to Wu Yuhong, a regular practice of butchering pregnant animals for consumption would be in complete violation of all common sense.[48]

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[45] Wu "Ewes Without Lambs": 65-66.
[46] Wu Yuhong did not consider that ewes and does, like many other domesticated animals, often (but not always) give birth lying down. However, he pointed out that there is a clear connection between the Akkadian verb *niālum* "to lie down" and death in early Mesopotamia (Wu "Ewes Without Lambs": 67). As for the (rare) use of "to lie down" as a euphemism for "sexual intercourse," it is important to point out that this only applies to sexual intercourse that involves humans and/or anthropomorphic deities, and no evidence suggests (and we have no reason to assume) that animal reproduction was considered a horizontal activity in ancient Sumer.
[47] Note, however, that the syntactic structure of the two expressions remains different with this interpretation, since the $sila_4$/$maš_2$ would be the subject of nu_2-a, but the direct object of nu-a.
[48] Wu "Ewes Without Lambs": 72.

Reproductive Patterns of Domestic Sheep and Goats

Although Wolfgang Heimpel and Wu Yuhong both have presented some valid arguments in favor of an interpretation of u_8/ud_5 $sila_4$/$maš_2$ nu_2/nu-a as a designation used for infertile ewes and does, or otherwise poor breeders, the traditional understanding of the expression as "pregnant" have prevailed in the scholarly literature.[49] Moreover, as the above review of previous scholarship regarding the meaning of the Sumerian expression demonstrates, the debate so far has primarily been concerned with linguistics and, perhaps more than anything else, arguments based on what we would consider common sense. What has been almost entirely omitted in the discussions so far are data derived from the fields of zoology and ruminant embryology, which can be of significant help for our understanding of these references. For example, they could tell us what sheep and goat breeders already know, namely that the estrus activity in sheep and goats is inherently seasonal, and unlike most other domestic livestock species, sheep and goats maintained at temperate latitudes (> 25°) typically have a marked seasonality of breeding activity.[50] This phenomenon, which is a manifestation of a reproductive strategy for the survival of the species, is a result of the fact that ewes and does ovulate naturally in response to the shortening of the day and the decrease in daylight hours that occurs in the fall.[51] Sheep and goats are so-called short day breeders, which means that during the short photoperiods in the autumn, the production and release of melatonin from the pineal gland will stimulate sexual activity in the females. Conversely, seasonal anoestrus occurs when the day length increases in the spring, and this period is associated with an absence of estrus and ovulation in sheep and goats. In other words, there is a season during which the sheep and goats are pregnant, and there is a season during which they are not, although the seasonality can be somewhat manipulated and changed also in antiquity according to management practices and environmental conditions. Since the majority of the Ur III references to the expressions u_8 $sila_4$ nu_2/nu-a and ud_5 $maš_2$ nu_2/nu-a are dated by month according to the Puzriš-Dagan calendar, the seasonality of the breeding activity of the animals in the livestock center is imperative to our understanding of the expressions.

Important data on reproduction cycles and birth seasonality of ancient sheep and goats can be obtained through the analysis of tooth enamel oxygen isotope ratios,[52] and recently a team of scientists

[49] See, e.g., Sara Brumfield's recent edition of the text AA76 (2011), in which u_8 $sila_4$ nu-a is simply translated "pregnant ewes," with a reference to Steinkeller "Sheep and Goat Terminology" (S. Brumfield, "The Term ab_2-RI-e in Ur III Sources," *Cuneiform Digital Library Bulletin* 2011/2 [2011], accessed on 05/20/2019 at https://cdli.ucla.edu/pubs/cdlb/2011/cdlb2011_002.html), or Wu Yuhong, who despite his own discussion and rejection of the expression as a reference to pregnant animals in 1996, simply offered the translation "ewe/nanny-goat with (or without) lamb/kid," without any further comments, in his 2013 paper on the cooks working in the e_2-uz-ga institution in Puzriš-Dagan (Wu "Pairs of Cooks").

[50] J. Simões, "Recent Advances on Synchronization of Ovulation in Goats, Out of Season, for a More Sustainable Production," *Asian Pacific Journal of Reproduction* 4/2 (2015): 157-65.

[51] See e.g. P. Chemineau, B. Malpaux, J. A. Delgadillo, Y. Guérin, J. P. Ravault, J. Thimonier, and J. Pelletier, "Control of Sheep and Goat Reproduction: Use of Light and Melatonin," *Animal Reproduction Science* 30/1 (1992): 157-84; H. J. D. Rosa and M. J. Bryant, "Seasonality of Reproduction in Sheep," *Small Ruminant Research* 48/3 (2003): 155-71.

[52] E.g. M. Balasse, A. B. Smith, S. H. Ambrose, and S. R. Leigh, "Determining Sheep Birth Seasonality by Analysis of Tooth Enamel Oxygen Isotope Ratios: The Late Stone Age Site of Kasteelberg (South Africa)," *Journal of Archaeological*

have examined ten third molars belonging to ten different sheep from the Later Pre Pottery Neolithic – B (ca. 7500 cal B.C.) from the Mesopotamian site Tell Halula in the Middle Euphrates Valley, Syria.[53] The analysis indicated that the ten sheep, which were all slaughtered around 2 to 6 years, were born within a short time period of ca. 2.5 months (0.22 year), offering clear evidence of a marked seasonality of birth and fertility in early Mesopotamian herds. While herding practices in Neolithic Tell Halula no doubt would have differed from the more intensive sheep/goat management strategies of the Ur III period, the data is important since it provides evidence for regional birth seasonality in herds that likely were primarily kept for meat production.[54] Although there is some evidence of secondary animal products in the Middle East in the Neolithic,[55] there is no conclusive evidence in the faunal remains that this was more than opportunistic in this early period. Moreover, the analysis of the bone fragments from the site has demonstrated that most sheep in Tell Halula were culled as juveniles and subadults (52.3% of sheep specimens were killed within their first year), with a sex-ratio distribution in favor of females (increasing over time). This would be typical for herd structures focused on meat production as well as intensification of breeding and herd reproduction.[56]

Sheep and goat populations in current Iran provide us with a rough biological life cycle of ruminants that is unlikely to have been much different in antiquity. According to R. M. Acharya, who provided an overview of small ruminant production in arid and semi-arid regions in Asia in the 1980s, about 60% to 70% of the flocks in Iran are transhumant, migrating long distances following the seasonal growth, while the remaining 30% to 40% are stationary flocks where the animals are kept on grazing lands surrounding villages.[57] Mating in both the transhumant and stationary flocks would usually take place in September to October, over a period varying from 35 to 40 days, although some

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Science 30 (2003): 205-215; M. Balasse, G. Obein, J. Ughetto-Monfrin, and I. Mainland, "Investigating Seasonality and Season of Birth in the Past Herds: a Reference Set of Sheep Enamel Stable Oxygen Isotope Ratios," *Archaeometry* 54 (2012): 349-68; E. Blaise and M. Balasse, "Seasonality and Season of Birth of Modern and Late Neolithic Sheep from South-Eastern France Using Tooth Enamel $\delta^{18}O$ Analysis," *Journal of Archaeological Science* 38 (2011): 3085-93; C. Tornero, A. Bălăşescu, J. Ughetto-Monfrin, V. Voinea, and M. Balasse, "Seasonality and Season of Birth in Early Eneolithic Sheep from Cheia (Romania): Methodological Advances and Implications for Animal Economy," *Journal of Archaeological Science* 40 (2013): 4039-55.

[53] C. Tornero, M. Balasse, M. Molist, and M. Saña, "Seasonal Reproductive Patterns of Early Domestic Sheep at Tell Halula (PPNB, Middle Euphrates Valley): Evidence from Sequential Oxygen Isotope Analyses of Tooth Enamel," *Journal of Archaeological Science: Reports* 6 (2016): 810-18.

[54] See A. Sherratt, "Plough and Pastoralism: Aspects of the Secondary Products Revolution," in *Pattern of the Past: Studies in Honour of David Clarke*, eds. I. Hodder, G. L. Isaac and N. Hammond (Cambridge, 1981), 261-305; and A. Sherratt, "The Secondary Exploitation of Animals in the Old World," *World Archaeology* 15/1 (1983): 90-104.

[55] See H. J. Greenfield, "The Secondary Products Revolution: the Past, the Present and the Future," *World Archaeology* 42/1 (2010): 29-54.

[56] Tornero *et al.* "Seasonal Reproductive Patterns": 811.

[57] R. M. Acharya, "Small Ruminant Production in Arid and Semi-Arid Asia," in *Small Ruminant Production in the Developing Countries: Proceedings of an Expert Consultation held in Sofia, Bulgaria, 8–12 July 1985*, eds. V. M. Timon and J. P. Hanrahan, FAO Animal Production and Health Papers, vol. 58 (Rome, 1986), accessed on 05/12/2019 at http://www.fao.org/docrep/009/ah221e/AH221E14.htm#ch14. In her recent monograph on early Mesopotamian pastoralism, Anne Porter has argued for a less pronounced socio-political distinction between nomadic, semi-nomadic and sedentary communities in the ancient Near East, and suggested that transhumant pastoralists in early Mesopotamia in fact belonged to the same social, political and familial entities as farmers, although concrete evidence for this radical re-interpretation remains somewhat tenuous (Porter, *Mobile Pastoralism*, 13-14; see also the reviews by Mitchell S. Rothman in *Bulletin of the American Schools of Oriental Research* 373 [2014]: 214-217, and Steven A. Rosen in *Journal of Near Eastern Studies* 74/1 [2015]: 153-155).

data indicated that some herders would keep their rams with the ewes for longer periods of time trying to increase productivity. The lambing season would typically occur in February to March and be followed by a period of roughly four months when the animals are anoestrus, and not able to breed.[58] To a goat or sheep breeder, this state is referred to as post-partum anoestrus, or PPA.

Ethnographic studies of pastoral tribes in Iran have produced very similar data, with lambs and kids being born during a short period of time in the late winter/early spring among the Qashqa'i,[59] or from early February to the middle/end of March among the Baxtyâri.[60] The breeding cycle for both transhumant and stationary flocks of sheep and goats in Iran may be summarized:

- Mating: September-October (35 to 40 days)
- Birth: February-March
- Anoestrus: April-July (approximately 4 months)

If mating and birth are seasonal among sheep and goats in Mesopotamia, we would expect this seasonality to be reflected in the monthly distribution of references to ewes and does classified as $sila_4$/$maš_2$ nu_2/nu-a as in the Ur III documentation from Puzriš-Dagan.[61]

Discussion and Analysis of the Textual Data

Of the ca. 16,000 published cuneiform tablets from Puzriš-Dagan, approximately 1,200 were never dated by month, or do not have preserved or legible month formulas. According to the *BDTNS* (accessed on 01/26/2019), 81 of the remaining tablets with month formulas offer 99 references to ewes classified as $sila_4$ nu_2/nu-a, while 94 tablets provide 131 references to does classified as $maš_2$ nu_2/nu-a. These references are typically used for single ewes or does, or for smaller groups of animals, although there are a few exceptions where more significant numbers of animals are recorded in single texts (e.g. *TRU* 405, *AUCT* 3 67, *Princeton* 2 72, *SAT* 3 1927). Taking appropriate measures to avoid any double-counting (some references are clearly repeat listings of the same animals), we may conclude that these tablets together list a total of 268 ewes and 345 does classified as $sila_4$/$maš_2$ nu_2/nu-a.

To provide a direct conversion of the Ur III months to the months in our modern calendar is complicated, because the 12-month lunisolar calendar used in ancient Mesopotamia was approximately 11 days shorter than the seasonal (solar) year, which of course has been used to

[58] Simões "Synchronization of Ovulation in Goats": 158.
[59] Beck, *Nomad*.
[60] J.-P. Digard, *Techniques des nomades baxtyâri d'Iran* (Cambridge/Paris, 1981).
[61] The pregnancy and gestation of domesticated sheep and goats are more or less identical, and their reproductive patterns can therefore be treated together. Both sheep and goats have their natural breeding seasons in the fall, with gestation periods averaging around 150 days, although the precise length varies slightly from breed to breed.

(artificially) set the length of our months. In order to synchronize the lunisolar calendar with the seasonal year, the Ur III administrators would insert an intercalary 13th month every 2-3 years. In other words, depending on the local intercalary cycle, the first month in the Ur III calendar used in Puzriš-Dagan could correspond to April in one year, but to May in another year, and the month conversions used here can therefore only be taken as rough estimates.[62]

Nevertheless, these approximate conversions allow us to compare the seasonal distribution of Ur III references to ewes and does classified as $sila_4$/$maš_2$ nu_2/nu-a with the seasonal reproductive cycles of Mesopotamian sheep and goats.[63]

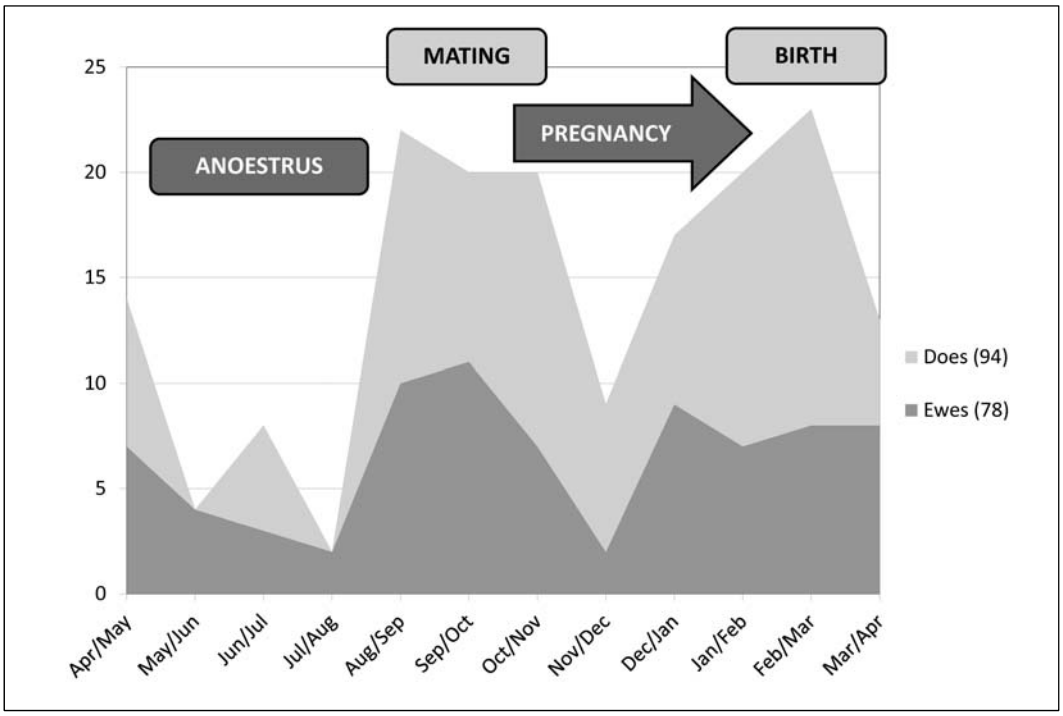

Figure 1. Seasonal distribution of Ur III tablets listing ewes and does classified as $sila_4$/$maš_2$ nu_2/nu-a compared to a reconstruction of the breeding cycle of Mesopotamian ewes and does

[62] For the nature of the Sumerian calendar and the use of regular and intercalary months in the Ur III administration, see T. Sharlach, "Calendars and Counting," in *The Sumerian World*, ed. H. Crawford (London/New York, NY, 2013), 313-15.
[63] Note that the three texts *AUCT* 3 67, *Princeton* 2 72, and *SAT* 3 1927 from the first month of Ibbi-Suen 1 have been excluded in the comparisons. These texts list large numbers (27, 20, and 20) of u_8 $sila_4$ nu-a as a part of Sippar's transfer of sheep to Puzriš-Dagan within the city's bala obligation to the Ur III state (see Sharlach, *Provincial Taxation*, 368), and these animals clearly did not form a part of the regular livestock management activities at Puzriš-Dagan.

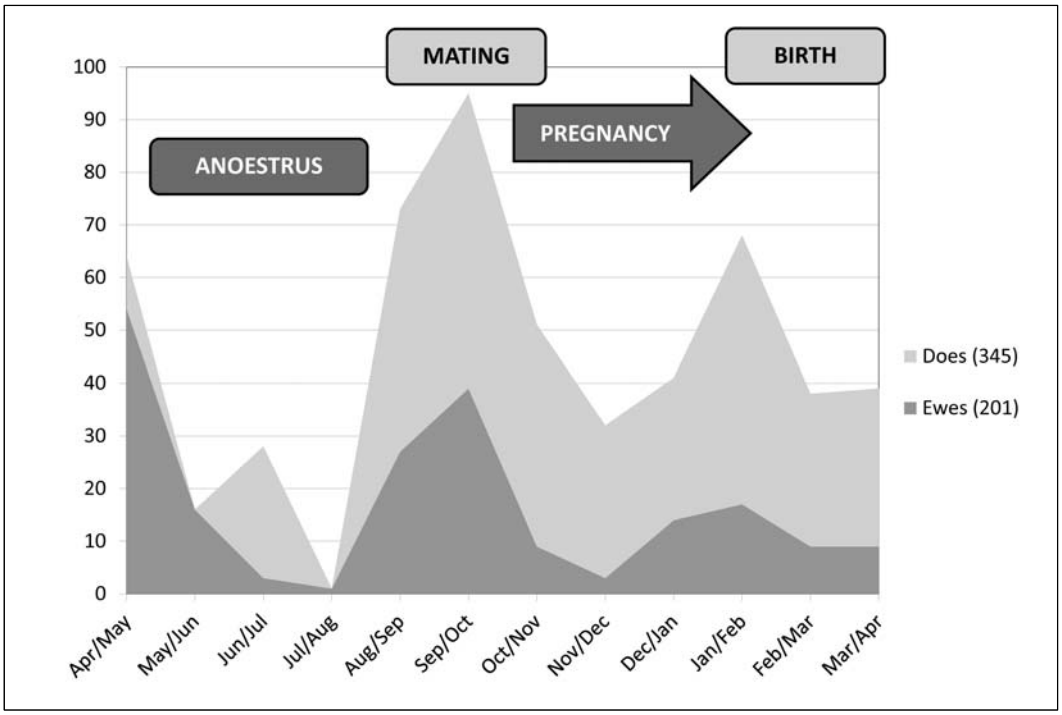

Figure 2. Seasonal distribution of the numbers of ewes and does classified with sila$_4$/maš$_2$ nu$_2$/nu-a in the Ur III tablets compared to a reconstruction of the breeding cycle of Mesopotamian ewes and does

There is a clear (and expected) correlation between the seasonal distribution of tablets recording sila$_4$/maš$_2$ nu$_2$/nu-a (*Figure 1*), and the distribution of the number of actual animals with the classification (*Figure 2*). With the exception of July/August (the fourth month in Puzriš-Dagan), ewes and does classified with sila$_4$/maš$_2$ nu$_2$/nu-a were observed and recorded throughout the year, with two clearly distinguishable peaks during the periods of mating and birth, and a pronounced and expected decline of attestations during the summer months when the females were anoestrus. The data supports the marked seasonality of birth and fertility in sheep and goats of the Ur III period, as suggested by ethnographic studies and the analysis of oxygen isotope ratios of tooth enamel in ancient Mesopotamian sheep.

The clear increase in attestations of sila$_4$/maš$_2$ nu$_2$/nu-a immediately before (January/February) and during the birth season (February/March), could perhaps reflect an increase in observations and recordings of pregnancies, and would thus support the original interpretation of the expression as a classification for pregnant animals. However, the large number of attestations in April/May appear too late in the year for sheep and goat pregnancies in Mesopotamia, and it is unlikely that these attestations refer to pregnant animals. A more plausible interpretation would therefore be that the earlier attestations in this accumulation (December/January) represent non-pregnant animals, whose failure to conceive during the mating period is becoming apparent to the

shepherds. The observations and records from the actual birth season (February/March) would primarily represent animals that have aborted their fetuses, abandoned their offspring, or given birth to stillborn lambs/kids. Finally, the later attestations from April/May (and onwards during the anoestrus period) would simply be observations and records of ewes and does without lambs/kids.

The other pronounced increase in references to ewes/does classified as $sila_4$/$maš_2$ nu_2/nu-a coincides with the mating period (September/October). As mentioned above, pregnancies in sheep and goats can only be determined during the later stages of gestation by means of a visual inspection or palpitation (the two methods available to the ancient shepherds), and these records made in September/October/November can therefore not be references to pregnant animals. Instead, it seems likely that they refer to animals that for some reason are not coming into heat, and therefore are not mounted by the rams/bucks. As mentioned above, sexually mature ewes and does that have failed to breed for 2-3 estrus cycles should be identified and considered for culling. Once the mating period is over, there is a sharp decline in the attestation of ewes and does classified with $sila_4$/$maš_2$ nu_2/nu-a, which lasts until the later stages of gestation when pregnancies (and therefore also animals not being pregnant) become possible to determine based on observation alone.

The Ur III State and Puzriš-Dagan

The consumption of animals and the slaughtering patterns within the organization of Puzriš-Dagan remained largely unaffected by the seasonality and season of births among the sheep and goats in the various herds of the livestock center. For example, no clear pattern can be identified in the seasonal distribution of the 676 texts returned by *BDTNS* (accessed on 02/24/2019), recording šu-gid_2 deliveries of animals to the kitchen in Puzriš-Dagan (šu-gid_2 e_2-muhaldim).[64] The mean number of tablets for each month was 53 (median: 53), with a sample standard deviation (s_x) of 8. More significantly, the royal bureaucracy of Puzriš-Dagan would not appear to have allowed the inherent mating and birth seasonality in the small livestock herds to disrupt the timing of the frequent animal deliveries from the pastoral communities within the Ur III state and its outlying territories.[65] Such deliveries to Puzriš-Dagan were meticulously recorded in the so-called mu-ku_x (DU) delivery tablets.[66] According to the *BDTNS* (accessed on 02/24/2019), a total of 3,080 texts record mu-ku_x

[64] See Tsouparopoulou "Killing and Skinning Animals": 153-54. According to Wu Yuhong, the animals classified as šu-gid_2, which typically were sent to the kitchen (e_2-muhaldim) rather than the exclusive e_2-uz-ga institution, were of very low quality, and primarily intended for consumption by common servants and soldiers (Wu "Ewes Without Lambs": 72).
[65] Note that a significant number of the animals recorded in Puzriš-Dagan arrived in the form of gifts from notables within the state (high level officials, military commanders, Amorite allies, etc.), often in connection to military campaigns (see Garfinkle, "Limits of State Power in Early Mesopotamia": 161-62). While some of these animals no doubt also originated from the pastoral communities in the outlying territories, others would have been sourced from within the traditional boundaries of the state from management systems that did not involve our traditional notions of pastoralists.
[66] See e.g. T. Maeda, "Bringing (mu-túm) Livestock and the Puzurish-Dagan Organization in the Ur III Dynasty," *Acta Sumerologica* 11 (1989): 69-111.

(DU) deliveries of livestock to the center, of which 2,894 can be dated to one of the twelve regular Sumerian months used in Puzriš-Dagan. The texts are distributed remarkably consistent over the twelve months of the year, displaying only a slight increase in numbers during the autumn, with close to half of the texts (approximately 47%) dated to the Sumerian months 5-9. The monthly mean of tablets was 241 (median: 235), with a sample standard deviation (s_x) of only 35.

As mentioned above, Puzriš-Dagan was specifically founded by king Šulgi to serve the administrative and economic needs of the Ur III state, perhaps as a result of the state's ambition to extend its control over the transhumant pastoralists living in the marginal areas of the state. In this capacity, it was operating as an administrative instrument of the central authority, without any traditional administrative structures of its own; a reflection of the increased administrative and economic domination of the Ur III state.[67] The nature of the interconnection between the livestock management officials operating in Puzriš-Dagan on behalf of the royal administration, and the pastoral communities in the outlying territories fulfilling their various responsibilities to the state, highlights a common problem with centralization of authority and power, in which the central bureaucracy enforce arbitrary and inefficient policies on the front line agencies, thereby disconnecting the state from the local and regional communities.[68] As argued by Piotr Michalowski, some of the main causes of the decline and collapse of the Ur III state, after only a century of domination, were in all likelihood embedded in the rigid bureaucratic structures of the central authority, and its relationship and interactions with the local and regional communities of the state.[69]

Conclusions

The analysis of the textual data presented in this article demonstrates a marked seasonality in birth and fertility in sheep and goats managed in the royal livestock center Puzriš-Dagan in the Ur III period, reinforcing the hypothesis that the majority of these animals would have been brought in from pastoral systems north of Babylonia (around or above the 35th parallel). The data show a short mating season in the autumn (September-October), with lambing taking place in the early spring (February-March). This breeding pattern resembles the reproductive sheep and goat cycles found in traditional husbandry systems with both transhumant and sedentary herds in current Iran, and appears to be

[67] Tsouparopoulou, *Ur III Seals*, 9; see also Garfinkle "Was the Ur III State Bureaucratic?": 58; Porter, *Mobile Pastoralism*, 306-307 and 324.
[68] A similar observation was made by Melinda Zeder in her 1994 study of administrative procedure and animal management in Puzriš-Dagan, where she concluded that the administrative and bureaucratic routines and needs of the Ur III state were prioritized over issues related to animal husbandry and herding practices (M. A. Zeder, "Of Kings and Shepherds: Specialized Animal Economy in UR III Mesopotamia," in *Chiefdoms and Early States in the Near East: the Orgnizantional Dynamics of Complexity*, eds. M. Rothman and G. Stein [Madison, WI, 1994], 186).
[69] Michalowski "Charisma and Control": 53 and 56-57.

further supported by a recent study of oxygen isotope ratios of tooth enamel from ancient sheep from Tell Halula in the Middle Euphrates Valley in modern Syria.

The breeding cycle of the sheep and goats help us in establishing the import of the Sumerian expression u_8/ud_5 nu_2/nu-a, as a classification used for ewes and does in Puzriš-Dagan, that for various reasons were unable to conceive or give birth to healthy lambs/kids, possibly to be literally understood "ewe/doe (whose) lamb/kid lied down (in death)". The prompt identification and removal of infertile or non-productive animals is essential in any productive animal management system, and the evidence suggests that the Ur III ewes/does without lambs/kids were destined for culling and subsequent human consumption. They were frequently dispatched to the state controlled kitchen or commissariat, or to the enigmatic establishment referred to as e_2-uz-ga, which prepared food for the king and the royal court.

The seasonality of the reproductive cycle would have had an impact on the availability of secondary animal products in sedentary and transhumant herds in the marginal areas of the Ur III state, and it would also have constituted a major factor for the management strategies and overall movements of the transhumant herders and pastoralists, who ultimately provided a significant portion of the animals. However, the cuneiform texts recovered from Puzriš-Dagan do not indicate that the central authority of the Ur III state accommodated in its bureaucratic routines this marked seasonality of breeding activity in the sheep and goats brought in from these communities. Livestock would continue to be collected and recorded in the archives of Puzriš-Dagan throughout the year, with no discernible interruptions or seasonal fluctuations, highlighting the detachment and disconnect between the bureaucratic system established by the Ur III kings, and the regional communities upon which the state ultimately relied.